



U.S. Department
of Transportation
**Federal Aviation
Administration**

Advisory Circular

Subject: Change 13 to STANDARDS FOR SPECIFYING
CONSTRUCTION OF AIRPORTS

Date: 1/30/01

Initiated by: AM-200

AC No: 150/5370-10A

Change: 13

1. PURPOSE. ITEM D-701 PIPE FOR STORM DRAINS AND CULVERTS has been revised to update material specifications and ITEM D-705 PIPE UNDERDRAINS FOR AIRPORTS has been revised to update material specifications and to add standards for filter fabric.

2. PRINCIPAL CHANGES. The following principal changes have been made:

a. Paragraph 701-2.1 has been revised to add a note to the engineer to indicate class, gage, schedule, SDR, and/or strength of all pipe desired.

b. Paragraph 701-2.2 has been revised to update the AASHTO M 294 reference, which now includes specification for pipe diameters up to 1200 mm.

c. Paragraph 701-2.4 has been revised to add "...and polyethylene pipe.. ." and to delete reference to oakum.

d. Paragraph 705-2.8 CONTROLLED LOW STRENGTH MATERIAL (CLSM) has been added to specify requirements for **flowable** backfill.

e. Paragraph 701-3.4 has been revised to delete reference to oakum.

f. Paragraph **701-3.4c** has been revised to add AASHTO M 294M to fitting requirements.

g. Paragraph 705-2.1 has been divided into paragraphs 2.1 GENERAL and paragraph 705-2.2 PIPE. The reference to AASHTO M 294M has been updated.

h. Paragraph 705-2.6 GRANULAR MATERIAL has been revised to include references to ASTM and AASHTO materials.

i. Paragraph 705-2.7 FILTER FABRIC meeting AASHTO requirements for Class 2 filter fabric has been added.

j. Paragraph 705-2.8 CONTROLLED LOW STRENGTH MATERIAL (CLSM) has been added to specify requirements for **flowable** backfill.

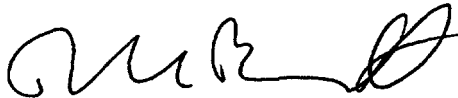
k. New paragraphs **705-3.3c** PVC or Polyethylene Pipe and **705-3.3e** Filter Fabric have been added.

l. New paragraphs **705-3.6c** Controlled Low Strength Material (CLSM) and **705-3.6d** Deflection Testing have been added.

m. Paragraph 705-4.3 has been added to provide a method of measurement for filter fabric and a basis of payment item for filter fabric has been added.

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
261 to 265	2/17/89 or 5/20/98	261 to 265-1	1/30/01
267 to 272	2/17/89 or 5/20/98	267 to 272	1/30/01



DAVID L. BENNETT

Director, Office of Airport Safety and Standards

ITEM D-701 PIPE FOR STORM DRAINS AND CULVERTS

DESCRIPTION

701-1.1 This item shall consist of the construction of pipe culverts **and storm drains in** accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

MATERIALS

701-2.1 Materials shall meet the requirements shown on the plans and specified below.

The Engineer should indicate the required class, schedule, SDR, gage, and/or strength of pipe desired.

701-2.2 PIPE. The pipe shall be of the type called for on the plans or in the proposal and **shall be in accordance with** the following appropriate requirements.

I	Metallic Coated Corrugated Steel Pipe (Type I, IR or II)	ASTM A 760
	Galvanized Steel Corrugated Structural Plates	
	and Fasteners for Pipe, Pipe-Arches, and Arches	ASTM A 761
	Polymer Precoated Corrugated Steel Pipe for Sewers and Drains	ASTM A 762
	Post-Coated and Lined (Bituminous or Concrete)	
	Corrugated Steel Sewer and Drainage Pipe	ASTM A 849
	Steel Sheet, Zinc and Aramid Fiber Composite Coated for	
I	Corrugated Steel Sewer, Culvert, and Underdrain Pipe	A885/A885M-96
	Corrugated Aluminum Alloy Culvert Pipe	ASTM B 745
	Non-Reinforced Concrete Pipe	ASTM C 14
	Reinforced Concrete Pipe	ASTM C 76
	Reinforced Concrete D-Load Pipe	ASTM C 655
	Reinforced Concrete Arch Pipe	ASTM C 506
	Reinforced Concrete Elliptical Pipe	ASTM C 507
	Precast Reinforced Concrete Box Sections	ASTM C 789 and C 850
	Poly (Vinyl Chloride) Ribbed Drain Pipe & Fittings	ASTM F 794
	Based on Controlled Inside Diameter	
	Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe	ASTM F 949
	With a Smooth Interior and Fittings	
	Bituminous-Coated Corrugated Metal Pipe and Pipe Arches	AASHTO M 190
	Bituminous-Coated Corrugated Aluminum Alloy Culvert Pipe	AASHTO M 190 and M 196
	Bituminous-Coated Structural Plate Pipe, Pipe Arch, and Arches	AASHTO M 167 and M 243
	Aluminum Alloy Structural Plate for Pipe, Pipe Arch, and Arches	AASHTOM219
	Polyvinyl Chloride (PVC) Pipe	ASTM D 3034
	Corrugated Polyethylene Drainage Tubing (all types)	AASHTO M 252
	Corrugated Polyethylene Pipe 300 to 1200 mm Diameter (all types)	AASHTO M 294M
	Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based	AASHTO M 304
	on Controlled Inside Diameter	

The Engineer shall select the pipe used for the project and may delete inappropriate requirements from paragraph 701-2.2 and from the list of material requirements.

 *****X*****

701-23 CONCRETE. Concrete for pipe cradles shall have a minimum compressive strength of 2000 psi (13.8 MPa) at 28 days and conform to the requirements of ASTM C 94.

701-2.4 RUBBER GASKETS. Rubber gaskets for rigid pipe shall conform to the requirements of ASTM C 443. Rubber gaskets for PVC pipe and polyethylene pipe shall conform to the requirements of ASTM F 477. Rubber

gaskets for zinc-coated steel pipe and precoated galvanized pipe shall conform to the requirements of ASTM D 1056, for the "RE" closed cell grades.

701-2.5 JOINT MORTAR. Pipe joint mortar shall consist of one part **portland** cement and two parts sand. The Portland cement shall **conform** to the requirements of ASTM C 150, Type I. The sand shall **conform** to the requirements of ASTM C 144.

701-2.6 JOINT FILLERS. Poured filler for joints shall conform to the requirements of ASTM D 1190.

701-2.7 PLASTIC GASKETS. Plastic gaskets shall conform to the requirements of AASHTO M 198 (Type B).

ASTM C 789 and C 850 are primarily manufacturing specifications. The box section dimensions, compressive strength of the concrete, and reinforcement details shown in the specifications have been designed for a combined earth dead load and AASHTO HS20 live load condition. A modified design will be necessary when aircraft loadings are greater than HS20 live loads.

*****x*****

[701-2.8. CONTROLLED LOW STRENGTH MATERIAL (CLSM). Controlled low strength material shall conform to the requirements of Item P-153. When CLSM is used all joints shall have gaskets.

Engineering Brief No. 55 Controlled Low Strength Material (CLSM), dated May 21, 1996 contains guidance for use of CLSM, and includes interim specification Item P-153. The locations where CLSM is permitted shall be shown on the plans. This paragraph and the option to allow Item P-153 in paragraph 7013.5 must agree.

I *****

CONSTRUCTION METHODS

701-3.1 EXCAVATION. The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but it shall not be less than the external diameter of the pipe plus 6 inches (150 mm) on each side. The trench walls shall be approximately vertical.

Where rock, **hardpan**, or other unyielding material is encountered, the Contractor shall remove it **from** below the foundation grade for a depth of at least 12 inches (300 mm) or one-half inch (12 mm) for each foot of fill over the top of the pipe (whichever is greater) but for no more than threequarters of the nominal diameter of the pipe. The width of the excavation shall be at least 1 foot (30 cm) greater than the horizontal outside diameter of the pipe. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over 6 inches (150 mm) in uncompacted depth to form a uniform but yielding foundation.

Where a **firm** foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the full trench width. The Engineer shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

The excavation for pipes that are placed in embankment fill shall not be made until the embankment has been completed to a height above the top of the pipe as shown on the plans.

7013.2 BEDDING. The pipe bedding shall conform to the class specified on the plans. When no bedding class is specified or detailed on the plans, the requirements for Class C bedding shall apply.

a. **Rigid Pipe. Class A** bedding shall consist of a continuous concrete cradle conforming to the plan details,

Class B bedding shall consist of a bed of granular material having a thickness of at least 6 inches (150 mm) below the bottom of the pipe and extending up around the pipe for a depth of not less than 30 percent of the pipe's vertical outside diameter. The layer of bedding material shall be shaped to fit the pipe for at least 10 percent of the pipe's vertical diameter and shall have recesses shaped to receive the bell of bell and spigot pipe. The bedding material shall be sand

or selected sandy soil, all of which passes a 3/8 inch (9 mm) sieve and not more than 10 percent of which passes a No. 200 (0.075 mm) sieve.

Class C bedding shall consist of bedding the pipe in its natural foundation to a depth of not less than 10 percent of the pipe's vertical outside diameter. The bed shall be shaped to fit the pipe and shall have recesses shaped to receive the bell of bell and spigot pipe.

b. Flexible Pipe. For flexible pipe, the bed shall be roughly shaped to fit the pipe, and a bedding blanket of sand or fine granular material shall be provided as follows:

Pipe Corrugation Depth		Minimum Bedding Depth	
in.	mm	in.	mm
112	12.5	1	25.0
1	25.0	2	50.0
2	50.0	3	75.0
2 - m	62.5	3-1/2	87.5

c. PVC and Polyethylene Pipe. For PVC and polyethylene pipe, the bedding material shall consist of **coarse** sands and gravels with a maximum particle size of **3/4-inch** (13 mm). For pipes installed under paved areas, no more than 12 percent of the material shall pass the No. 200 (0.075 mm) sieve. For all other areas, no more than 50 percent of the material shall pass the No. 200 (0.075 mm) sieve. The bedding shall have a thickness of at least 6 inches (150 mm) below the bottom of the pipe and extend up around the pipe for a depth of not less than 50 **percent** of the pipe's vertical outside diameter.

7013.3 LAYING PIPE. The pipe laying shall begin at the lowest point of the trench and proceed upgrade. The lower segment of the pipe shall be in contact with the bedding throughout its full **length**. Bell or groove ends of rigid pipes and outside circumferential laps of flexible pipes shall be placed facing upgrade.

Paved or partially lined pipe shall be placed so that the longitudinal center line of the paved segment coincides with the flow line.

Elliptical and elliptically reinforced pipes shall be placed with the manufacturer's top of pipe mark within five degrees of a vertical plane through the longitudinal axis of the pipe.

7013.4 JOINING PIPE. Joints shall be made with (1) **portland** cement mortar, (2) **portland** cement grout, (3) rubber gaskets, (4) plastic gaskets, or (5) coupling bands.

Mortar joints shall be made with an excess of mortar to form a continuous bead around the outside of the pipe and shall be finished smooth on the inside. Molds or **runners** shall be used for grouted joints in order to retain the poured grout. Rubber ring gaskets shall be installed to form a flexible watertight seal.

a. Concrete Pipe. Concrete pipe may be either bell and spigot or tongue and groove. The method of joining pipe sections shall be such that the ends are **fully** entered and the inner surfaces are reasonably flush and even. Joints shall be thoroughly wetted before mortar or grout is applied.

b. Metal Pipe. Metal pipe shall be **firmly** joined by form fitting bands **conforming** to the requirements of ASTM A 760 for steel pipe and AASHTO M 196 for aluminum pipe.

c. PVC and Polyethylene Pipe. Joints for PVC and Polyethylene pipe shall conform to the requirements of ASTM D 3212 when water tight joints are required. Joints for PVC and Polyethylene pipe shall conform to the requirements of AASHTO M 304 when soil tight joints are required. Fittings for polyethylene pipe shall **conform** to the requirements of AASHTO M 252 or M 294M.

701-3.5 BACKFILLING. Pipes shall be inspected before any backfill is placed, any pipes found to be out of alignment, unduly settled, or damaged shall be removed and relaid or replaced at the Contractor's expense.

Material for **backfill** shall be fine, readily compatible soil, granular material selected **from** the excavation or a source of the Contractor's **choosing**, or shall meet the requirements of Item P-1531. It shall not contain **frozen** lumps, stones that would be retained on a **2-inch** (50.0 mm) sieve, chunks of highly plastic clay, or other objectionable

material. No less than 95 percent of a granular backfill material shall pass through a 1/2 inch (12 mm) sieve, and no less than 9.5 percent of it shall be retained on a No. 4 (4.75 mm) sieve.

When the top of the pipe is even with or below the top of the trench, the backfill shall be compacted in layers not exceeding 6 inches (150 mm) on both sides of the pipe and shall be brought up one foot (30 cm) above the top of the pipe or to natural ground level, whichever is greater. Care shall be exercised to thoroughly compact the backfill material under the haunches of the pipe. Material shall be brought up evenly on both sides of the pipe.

When the top of the pipe is above the top of the trench, the backfill shall be compacted in layers not exceeding 6 inches (150 mm) and shall be brought up evenly on both sides of the pipe to 1 foot (30 cm) above the top of the pipe. The width of backfill on each side of the pipe for the portion above the top of the trench shall be equal to twice the pipe's diameter of 12 feet (3.5 m), whichever is less.

For PVC and polyethylene pipe, the backfill shall be placed in two stages; first to the top of the pipe and then at least 12 inches (300 mm) over the top of the pipe. The backfill material shall meet the requirements of paragraph 701-3.2c.

All backfill shall be compacted to the density required under Item P-152.

METHOD OF MEASUREMENT

70141 The length of pipe shall be measured in linear feet (meters) of pipe in place, completed, and approved. It shall be measured along the centerline of the pipe from end or inside face of structure to the end or inside face of structure, whichever is applicable. The several classes, types and size shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipe being measured.

701-4.2 The volume of concrete for pipe cradles to be paid for shall be the number of cubic yards (cubic meters) of concrete which is completed in place and accepted.

7014.3 The volume of rock to be paid for shall be the number of cubic yards (cubic meters) of rock excavated. No payment shall be made for the cushion material placed for the bed of the pipe.

BASIS OF PAYMENT

7015.1 Payment will be made at the contract unit price per linear foot (meter) for each kind of pipe of the type and size designated; at the contract unit price per cubic yard (cubic meter) of concrete for pipe cradles; and at the contract unit price per cubic yard (cubic meter) for rock excavation.

These prices shall fully compensate the Contractor for furnishing all materials and for all preparation, excavation, and installation of these materials; and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item 701-5.1 [] inch [] per linear foot (meter)

Item 701-5.2 Concrete for pipe cradles-per cubic yard (cubic meter)

Item 701-5.3 Rock excavation-per cubic yard (cubic meter)

The Engineer shall specify the size and type of pipe for each pipe size specified in the plans.

MATERIAL REQUIREMENTS

ASTM A 760 Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

ASTMA761 Steel Galvanized, Corrugated Structural Plates and Fasteners for Pipe, Pipe-Arches, and Arches

ASTM A 762	Precoated (Polymeric) Galvanized Steel Sewer and Drainage Pipe
ASTMA849	Post-Coated and Lined (Bituminous or Concrete) Corrugated Steel Sewer and Drainage Pipe
ASTM A 885	Steel Sheet, Zinc and Aramid Fiber Composite Coated for Corrugated Steel Sewer, Culvert, and Underdrain Pipe
ASTM B 745	Corrugated Aluminum Alloy Culvert Pipe
ASTM C 14	Concrete Sewer, Storm Drain , and Culvert Pipe
ASTM C 76	Reinforced Concrete Culvert, Storm Dram, and Sewer Pipe
ASTM C 94	Ready Mixed Concrete
ASTM C 144	Aggregate for Masonry Mortar
ASTM c 150	Portland Cement
ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 506	Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C 507	Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
ASTM C 655	Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe
ASTM C 789	Precast Reinforced Concrete Box Sections for Culverts, Storm Drama and Sewers
ASTM C 850	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers with Less than 2 feet of cover
ASTM D 1056	Flexible Cellular Materials-Sponge or Expanded Rubber
ASTMD 1190	Concrete Joint Sealer, Hot Poured Elastic Type
ASTM D 3034	Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 794	Poly (Vinyl Chloride) Ribbed Drain Pipe & Fittings Based on Controlled Inside Diameter
ASTM F 949	Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe With a Smooth Interior and Fittings
AASHTO M 190	Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M 196	Corrugated Aluminum Alloy Culverts and Underdrains
AASHTO M 198	Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets

AASHTO M 219 Aluminum Alloy Structural Plate for Pipe, Pipe-Arches, and Arches

AASHTO M 243 Field Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches

AASHTO M 252 Corrugated Polyethylene Drainage Tubing

I AASHTO M 294M Corrugated Polyethylene Pipe, 300 to 1200 mm Diameter

AASHTO M 304 Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter

END ITEM D-701

ITEM D-705 PIPE UNDERDRAINS FOR AIRPORTS

DESCRIPTION

705-1.1 This item shall consist of the construction of pipe drains in accordance with these specifications and in reasonably close conformity with the lines and grades shown on the plans.

MATERIALS

705-2.1 GENERAL. Materials shall meet the requirements shown on the plans and specified below.

705-2.2 PIPE. The pipe shall be of the type called for on the plans or in the proposal and shall be in accordance with the following appropriate requirements.

Perforated Concrete Pipe	ASTM C 444
Porous Concrete Pipe	ASTM C 654
Polymer Precoated Perforated Corrugated Steel Pipe	ASTM A 762
Perforated Corrugated Aluminum Alloy Pipe	AASHTO M 196
Smooth-Wall Perforated PVC Pipe	ASTM F 758
Poly (Vinyl Chloride) Ribbed Drain Pipe & Fittings	
Based on Controlled Inside Diameter	ASTM F 794
Poly (Vinyl Chloride)(PVC) Corrugated Sewer	
Pipe With a Smooth Interior and Fittings	ASTM F 949
Perforated Corrugated Steel Pipe	ASTM A 760
Bituminous-Coated Perforated Corrugated	AASHTO M 196
Aluminum Alloy Pipe	and M 190
Corrugated Polyethylene Drainage Tubing (all types)	AASHTO M 252
Corrugated Polyethylene Pipe, 300 to 1200 mm Diameter (all types)	AASHTO M 294M
Poly (Vinyl Chloride) (PVC) Profile Wall Drain Pipe and	AASHTO M 304
Fittings Based on Controlled Inside Diameter	

The Engineer shall **select** the pipe used for the project and may delete inappropriate requirements from paragraph 705-2.2 and from the list of material requirements.

705-2.3 JOINT MORTAR. Pipe joint mortar shall consist of one part **portland** cement and two parts sand. The **portland** cement shall **conform** to the requirements of ASTM C 150, Type I. The sand shall conform to the requirements of ASTM C 144.

705-2.4 ELASTOMERIC SEALS. Elastomeric seals shall conform to the requirements of ASTM F 477.

705-2.5 POROUS BACKFILL. Porous backfill shall be **free** of clay, humus, or other objectionable matter, and shall conform to the gradation in Table 1 when tested in accordance with ASTM C 136.

TABLE 1. GRADATION OF POROUS BACKFILL

Sieve Designation (square openings)	Percentage by Weight Passing Sieves	
	Porous Material No. 1	Porous Material No. 2
1-1/2 inch (38 mm)		100
1 inch (25 mm)		90-100
3/8 inch (9.5 mm)	100	25-60
No. 4 (4.75 mm)	95-100	5-40
No. 8 (2.36 mm)		0-20
No. 16 (1.18 mm)	45-80	
No. 50 (0.30 mm)	10-30	
No. 100 (0.15 mm)	0-10	

When two courses of porous backfill are specified in the plans, the finer of the materials shall conform to particle size tabulated herein for porous material No. 1. The coarser granular material shall meet the gradation given in the tabulation for porous material No. 2.

705-2.6. GRANULAR MATERIAL. Granular material used for backfilling shall conform to the requirements of ASTM D 2321 for Class IA, IB, or II materials, or shall meet the requirements of AASHTO Standard Specification for Highway Bridges Section 30.

705-2.7. FILTER FABRIC. The filter fabric shall conform to the requirements of AASHTO M 288-99, Class 2.

The Engineer shall specify Class 2 unless sufficient survivability information is available for a reduction in minimum property requirements. Permittivity and Apparent Opening Sii requirements shall be based on knowledge of in situ soil.

705-2.8. CONTROLLED LOW STRENGTH MATERIAL (CLSM). Controlled low strength material shall conform to the requirements of Item P-153. When CLSM is used all joints shall have elastomeric seals.

Engineering Brief No. 55 Controlled Low Strength Material (CLSM), dated May 21, 1994, contains guidance for use of CLSM, and includes interim specification Item P-153. The locations where CLSM is permitted shall be shown on the plans.

I

CONSTRUCTION METHODS

705-3.1 EQUIPMENT. All equipment necessary and required for the proper construction of pipe underdrains shall be on the project, in first-class working condition, and approved by the Engineer before construction is permitted to start.

705-3.2 EXCAVATION. The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe, but shall not be less than the external diameter of the pipe plus 6 inches (150 mm) on each side. The trench walls shall be approximately vertical.

Where rock, **hardpan**, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least 4 inches (100 mm). The excavation below grade shall be backfilled with selected fine **compressible** material, such as silty clay or loam, and lightly compacted in layers not over 6 inches (150 mm) in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to sort, spongy, or other unstable soil, the unstable soil shall be removed and replaced with approved granular material for the fill trench width. The Engineer shall determine the depth of removal necessary. The granular material shall be compacted to provide adequate support for the pipe.

Excavated material not required or acceptable for backfill shall be disposed of by the Contractor as directed by the Engineer. The excavation shall not be carried below the required depth; when this is done, the trench shall be backfilled at the **Contractor's** expense with material approved by the Engineer and compacted to the density of the surrounding earth material.

The bed for the pipe shall be so shaped that at least the lower quarter of the pipe shall be in continuous contact with the bottom of the trench. Spaces for the pipe bell shall be excavated accurately to size to clear the bell so that the barrel supports the entire weight of the pipe.

The Contractor shall do such trench bracing, sheathing, or shoring necessary to perform and protect the excavation as required for safety and conformance to governing laws. Unless otherwise provided, the bracing, sheathing, or shoring shall be removed by the Contractor **after** the completion of the backfill to at least 12 inches (300 mm) over the top of the pipe. The sheathing or shoring shall be pulled as the granular backfill is placed and compacted to avoid any unfilled spaces between the trench wall and the backfill material. The cost of bracing, sheathing, or shoring, and the removal of same, shall be included in the unit price bid per foot (meter) for the pipe.

705-3.3 LAYING AND INSTALLING PIPE.

a. **Concrete Pipe.** The laying of the pipe in the finished trench shall be started at the lowest point and laid upgrade. When bell and spigot pipe is used, the bells shall be laid upgrade. If tongue and groove pipe is used, the groove end shall be laid upgrade. Holes in perforated pipe shall be placed down, unless otherwise shown on the plans. The pipe shall be **firmly** and **accurately** set to line and grade so that the invert will be smooth and uniform. Pipe shall not be laid on **frozen** ground.

Pipe which is not true in alignment, or which shows any settlement **after** laying, shall be taken up and **relaid** without extra compensation.

b. **Metal Pipe.** The metal pipe shall be laid with the separate sections joined **firmly** together with bands, with outside laps of circumferential joints pointing upgrade, and with longitudinal laps on the sides. Any metal in the pipe or bands which is not protected thoroughly by **galvanizing** shall be coated with a suitable asphaltum paint.

During installation, the asphalt-protected pipe shall be handled without damaging the asphalt coating. Any breaks in the bitumen or treatment of the pipe shall be refilled with the type and **kind** of bitumen used in coating the pipe originally.

c. **PVC or Polyethylene Pipe.** PVC or polyethylene pipe shall be installed in accordance with the **requirements** of ASTM D 232 1 or AASHTO Standard Specification for Highway Bridges Section 30. **Perforations** shall meet the requirements of AASHTO M 252 or M 294 Class 2, unless otherwise indicated on the plans. The pipe shall be laid accurately to line and grade.

d. **All Types of Pipe.** The upgrade end of pipelines, not **terminating** in a structure, shall be plugged or capped as approved by the Engineer.

Unless otherwise shown on the plans, a **4-inch** (100 mm) bed of granular backfill material shall be **spread** in the bottom of the trench throughout the entire length under all perforated pipe underdrains.

Pipe outlets for the underdrains shall be constructed when required or shown on the plans. The pipe shall be laid with tight-fitting joints. Porous backfill is not required around or over pipe outlets for underdrains. All connections to other drainage pipes or structures shall be made as required and in a satisfactory manner. If connections are not made to other pipes or structures, the outlets shall be protected and constructed as shown on the plans.

e. **Filter Fabric.** The filter fabric shall be installed accordance with the manufacturer's recommendations, or in accordance with AASHTO M 288-99 APPENDIX, unless otherwise shown on the plans.

705-3.4 MORTAR. The mortar shall be of the desired consistency for caulking and filling the joints of the pipe and for **making** connections to other pipes or to structures. Mortar that is not used within 45 minutes after water has been added shall be discarded. Retempering of mortar shall not be permitted.

705-3.5 JOINTS IN CONCRETE PIPE. When open or partly open joints are required or specified, they shall be constructed as indicated on the plans. The pipe shall be laid with the ends fitted together as designed. If bell and spigot pipe is used, mortar shall be placed along the inside bottom quarter of the bell to center the following section of pipe.

The open or partly open joints shall be surrounded with granular material meeting requirements of porous **backfill** No. 2 or as indicated on the plans. This backfill shall be placed so its thickness will be not less than 3 inches (75 mm) nor more than 6 inches (150 mm), unless otherwise shown on the plans.

When the original material excavated from the trench is impervious, commercial concrete sand or granular material meeting requirements of porous backfill No. 1 shall surround porous backfill No. 2, as shown on the plans or as directed by the Engineer.

When the original material excavated from the trench is previous and suitable, it may be used as backfill in lieu of porous backfill No. 1, when indicated on the plans or as directed by the Engineer.

705-3.6 BACKFILLING.

a. **Earth.** All trenches and excavations shall be **backfilled** within a reasonable time after the pipes are installed, unless other protection of the pipe is directed. The backfill material shall be selected material from excavation or borrow; material which is placed within a nominal pipe diameter distance at the sides of the pipe and 1 foot (30 cm) over ~~the~~ top shall be material which can be readily compacted. It shall not contain stones retained on a **3-inch** (75 mm) sieve, **frozen** lumps, chunks of highly plastic clay, or any other material which is objectionable to the Engineer. The material shall be moistened or dried, if necessary to be compacted by the method in use. **Backfill** material shall be approved by the Engineer. Special care shall be taken in placing the backfill. Great care shall be used to obtain thorough compaction under the haunches and along the sides to ~~the~~ top of the pipe.

The backfill shall be placed in loose layers not exceeding 6 inches (150 mm) in depth under and around the pipe, and not exceeding 8 inches (200 mm) over the pipe. Successive layers shall be added and thoroughly compacted by hand and pneumatic tampers, approved by the Engineer, until the trench is completely filled and brought to the proper elevation. Backfilling shall be done in a manner to avoid injurious top or side pressures on the pipe.

In embankments and for other areas outside of pavements, the **backfill** shall be compacted to the density required for embankments in unpaved areas under Item P-152. Under paved areas, the **subgrade** and any backfill shall be compacted to the density required for embankments for paved areas under Item P-152.

b. **Granular Material.** When granular backfill is **required**, its placement in the trench and about the pipe shall be as shown on the plans. Special care shall be taken in placing the **backfill**. The granular backfill shall not contain a damaging amount of foreign matter, nor shall earth **from** the sides of the trench or from the **windrow** be allowed to filter into the **backfill**. When required by the Engineer, a template shall be used to properly place and keep separate the two sides of backfill. The backfill shall be placed in loose layers not exceeding 6 inches (150 mm) in depth and compacted by hand and pneumatic tampers to the requirements as given for earth backfill. Backfilling shall be done in a manner to avoid injurious top or side pressure on the pipe. The granular **backfill** shall be made to the elevation of the trench, as shown on the plans.

When perforated pipe is specified, granular **backfill** material shall be placed along the full length of the pipe. The position of the granular material shall be as shown on the plans. If the original material excavated **from** the trench is pervious and suitable, it shall be used in lieu of porous backfill No. 1.

When porous backfill is to be placed in paved or adjacent areas prior to the completion of grading or **subgrade** operations, the **backfill** material shall be placed immediately after laying the pipe. The depth of this granular **backfill** shall be not less than 12 inches (300 mm), measured from the top of the underdrain. During subsequent construction operations, this minimum **backfill** of 12 inches (300 mm) of depth shall not be disturbed until such time as the **underdrains** are to be completed. When the underdrains are to be completed, the unsuitable material shall be removed until the porous backfill is exposed. That part of the porous backfill which contains objectionable material shall be removed and replaced with suitable material. The cost of removing and replacing any such unsuitable material shall be borne by the Contractor.

Whenever a granular subbase blanket course is to be used under pavements which extends several feet beyond the edge of paving to the outside edge of the underdrain trench, the granular backfill material over the underdrains shall be

placed in the trench up to an elevation of 2 inches (50 mm) above the bottom surface of the granular subbase blanket course. Immediately prior to the placing of the granular subbase blanket course, the Contractor shall blade this excess trench backfill from the top of the trench onto the adjacent **subgrade** where it can be incorporated into the granular subbase blanket course. Any unsuitable material which remains over the underdrain trench shall be removed and replaced. The subbase material shall be placed to provide clean contact between the subbase material and the underdrain granular backfill material for the full width of the underdrain trench.

c. Controlled Low Strength Material (CLSM). Controlled low strength material shall conform to the requirements of Item P- 153.

d. Deflection Testing. The Engineer may at any time, notwithstanding previous material acceptance, reject or require re-installation of pipe that exceeds 5 percent deflection when measured in accordance with ASTM D 2321, including Appendices.

705-3.7 CONNECTIONS. When the plans call for connections to existing or proposed pipe or **structures**, these connections shall be watertight and made so that a smooth uniform flow line will be obtained throughout the drainage system.

705-3.8 CLEANING AND RESTORATION OF SITE. After the backfill is completed, the Contractor shall dispose of all surplus material, dirt, and rubbish from the site. Surplus dirt may be deposited in embankments, shoulders, or as ordered by the Engineer. Except for paved areas of the **airport**, the Contractor shall restore all disturbed areas to their original condition.

METHOD OF MEASUREMENT

705-4.1 The length of pipe to be **paid** for shall be the number of linear feet (meters) of pipe **underdrains** in place, completed and approved; measured along the centerline of the pipe from end or inside face of structure to the end or inside face of **structure**, whichever is applicable. **The** several classes, types, and sizes shall be measured separately. All fittings shall be included in the footage as typical pipe sections in the pipeline being measured

705-4.2 The quantity of porous backfill to be paid for shall be the number of cubic yards (cubic meters) of porous backfill No. 1 and No. 2, complete in place and accepted, and shall be determined **from** the dimensions **given** on the plans by typical trench sections indicating the placement of porous backfill or dimensions ordered by the Engineer.

705-4.3 The quantity of filter fabric to be paid for shall be the number of square yards (**square** meters) of filter fabric in place, completed, and approved; and shall be determined from the dimensions given on the plans by typical trench sections indicating the placement of filter fabric or dimensions ordered by the Engineer.

BASIS OF PAYMENT

705-5.1 Payment will be made at the contract unit price per linear foot (meter) for pipe underdrains of the type, class, and size designated; at **the** contract unit price [**per cubic yard (cubic meter)**][**per ton (metric ton)**] for porous backfill No.1; **the** contract unit price [**per cubic yard (cubic meter)**][**per ton (metric ton)**] for porous backfill No. 2, and at the contract **unit** price per square yard (square meter) for filter fabric. [**per linear foot (meter) COMPLETE (including porous backfill and filter fabric.)**] These prices shall be full compensation for furnishing all materials and for all preparation, excavation, and installation of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item D-705-5.1 [] inch pipe (mm pipe) [] per linear foot (meter)

Item D-705-5.2 Porous Backfill No. 1—[**per cubic yard (cubic meter)**][**per ton (metric ton)**]

Item D-705-5.3 Porous Backfill No. 2—[**per cubic yard (cubic meter)**][**per ton (metric ton)**]

Item D-705-5.4 Filter Fabric-per square yard (square meter)

[Item D-705-5.5 [] inch pipe (mm pipe) [] per linear foot (meter) COMPLETE (including porous backfill and filter fabric)]
 *****x*****

The Engineer shall specify the size and type of pipe, filter fabric, and backfill material for each pipe size and type specified in the plans.

MATERIAL REQUIREMENTS

ASTM A 760 Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains

ASTM A 762 Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains

ASTM C 136 Sieve or Screen Analysis of Fine and Coarse Aggregates

ASTM C 144 Aggregate for Masonry Mortar

ASTM C 150 Portland Cement

ASTM C 444 Perforated Concrete Pipe

ASTM C 654 Porous Concrete Pipe

I ASTM D 2321 Underground Installation of Flexible **Thermoplastic** Sewer Pipe

ASTM D 3034 Type PSM **Poly(Vinyl Chloride)** (PVC) Sewer Pipe and Fittings

ASTM F 477 Elastomeric Seals (Gaskets) for Joining Plastic Pipe

ASTM F 758 Smooth-Wall **Poly(Vinyl Chloride)** (**PVC**) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage

ASTM F 949 Poly (Vinyl **Chloride**)(**PVC**) Corrugated Sewer Pipe with a Smooth Interior and Fittings

AASHTO M 190 Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches

AASHTO M 196 Corrugated Aluminum Alloy Culverts and Underdrains

AASHTO M 252 Corrugated Polyethylene Drainage Tubing

AASHTO M 288-99 Geotextile Specification for Highway Applications

AASHTO M 294M Corrugated Polyethylene Pipe, **300** to 1200 mm Diameter

AASHTO Standard Specifications for Highway Bridges

END OF ITEM D-705

1. 1. 1.

2. 2. 2.

3. 3. 3.

4. 4. 4.

5. 5. 5.

6. 6. 6.

7. 7. 7.

8. 8. 8.

U.S. Department
of Transportation
**Federal Aviation
Administration**

800 Independence Ave., S.W.
Washington, D.C. 20591

FORWARDINGSERVICEREQUESTED